REMARKS

In light of the foregoing Amendments and following Remarks, reconsideration and allowance of the above-captioned application are respectfully requested.

The Applicants and their representative would like to thank Examiner Fuller for the time and courtesy he extended during a telephone interview with the undersigned Tuesday, June 6, 2006. During the interview, differences between the cited art and the pending application were discussed. Specifically, differences between the pending application, the low temperature formation methods of Sharma, et al., and the VLS methods discussed in the background of Sharma et al. and disclosed in Majumadar, et al. were discussed. Possible claim amendments were also discussed. The Examiner stated that amendments that clarify that the claimed thermal CVD processes do not encompass a template method, in which metals in the form of nanosized droplets are utilized as catalysts, may differentiate the claims over the cited art. Accordingly, the presently presented amendments are filed as a submission with a Request for Continued Examination under 37 C.F.R. §1.114.

Claims 1-37 are currently pending in the application, including independent claims 1, 15, 22, and 30. For instance, pending claim 1 is directed to a process for forming a nanostructure. The process includes providing a metal to a reaction chamber as a metal layer formed on a surface and heating the reaction chamber to a reaction temperature such that the metal layer becomes molten. In particular, the reaction temperature in the process of claim 1 will be between 650°C (support for this limitation can be found in the application as filed at Table 1) and about 1500°C (support for this amendment can be found throughout the application, and in particular at paragraph 32 and paragraph 40 and in the claims as filed). The process also includes flowing a vapor stream comprising a reactant through the reaction chamber, reacting the reactant with the metal via a thermal CVD process to form a reaction product, and forming a nanowire or a nanobelt that includes this reaction product.

In the Office Action, claims 1-37 were rejected under 35 U.S.C. 102(e) as being anticipated by Majumdar, et al. (U.S. Patent Application Publication No. 2002/0172820). Applicants respectfully submit that the presently pending claims patentably define over

the cited reference for at least the reason that Majumdar, et al. fails to disclose or suggest certain limitations of the pending claims.

Majumdar, et al. is directed to nanostructures that can be formed according to a modified VLS procedure that includes dissolving gas reactants in catalytic liquid nanoclusters that have been patterned on a substrate followed by the growth of the desired nanostructures. In contrast, and as discussed in the specification of the present application (for example at page 7, paragraphs 28-30), the presently claimed process provides a metal to a reaction chamber as a metal layer formed on a surface. The metal layer can be applied to the surface of a removable substrate or can be applied directly to a surface of the reactor furnace. Hence, the disclosed method can be economical, as the time consuming nanocluster droplet patterning processes required by Majumdar, et al. and described in paragraph 92 of the application are not necessary.

In addition, the metal of Majumdar, et al. is utilized solely as a catalyst during the formation process. As discussed in Majumdar, et al., for instance in paragraphs 90-94, the reactants are provided as gaseous reactants that dissolve in the nano-sized catalytic liquid followed by growth of the nanowhiskers. The nanowires and heterostructure nanowires of Majumdar, et al. are formed from the gaseous reactants that dissolve in the metal catalyst. They are not formed of the reaction product of a reaction between a gaseous reactant and the molten metal, as is found in the pending claims.

For at least these reasons, Applicants respectfully maintain that claims 1-37 patentably define over Majumdar, et al.

In the Office Action, claims 1-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sharma, et al. (U.S. Patent Application Publication 2003/0039602).

Sharma, et al. discloses a low temperature plasma enhanced CVD synthesis technique for growing semiconductor nanowires.

The processes of pending claims 1-10, in contrast, are thermal CVD processes that take place at higher temperatures than do the process disclosed by Sharma, et al. In particular, the thermal processes of claims 1-10 are carried out at a temperature of between 650°C and about 1500°C.

Sharma, et al. discusses the benefits of the low temperature formation processes (see, e.g., paragraph 50 and 51), and states explicitly that very low temperatures are required when gallium is the melt (paragraph 50). Accordingly, Applicants respectfully submit that no proper incentive exists for modifying the reference as suggested to arrive at the thermal CVD processes of claims 1-10 and Applicants maintain that claims 1-10 patentably define over Sharma, et al.

In the Office Action, claims 11-45 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sharma, et al. in view of Majumdar, et al. (Applicants have assumed that this rejection is directed to claims 11-37, as claims 38-45 have been previously cancelled.)

Applicants respectfully submit that the presently pending claims patentably define over the cited references for at least the reason that the cited references cannot be properly combined as suggested.

As discussed above, Sharma, et al. is directed to a low temperature, plasma enhanced CVD nanostructure formation process. Moreover, the teachings of Sharma, et al. disclose that the low temperature formation processes are not only preferred over high temperature processes but are required, specifically when gallium is the melt.

Majumdar, et al., in contrast, is a high temperature modified VLS method in which the liquid catalyst is patterned on the substrate as nano-sized clusters and the reactants are gaseous. According to the reference, "[t]he CVD process is preferably carried out at approximately 600°C to approximately 800°C" (paragraph [0091], Example 1). The reference goes on in this paragraph to teach that at this temperature, the catalyst nanoclusters (in this particular example, the gold nanoclusters) form a liquid alloy with the gaseous reactant (e.g., silicon) and spontaneously break up into nanometer-sized droplets of Au-Si alloy. Growth of the silicon nanowire is initiated upon supersaturation of the gold by the silicon. The reference teaches that the process should be carried out at the high temperatures in order to form the nanometer-sized alloy droplets and subsequent fibers.

Other examples in the application take place at even higher temperatures (Example 4, paragraph [144], 850°C to 950°C; Example 7, paragraph [204], 880°C to

905°C). Accordingly, the processes of Majumdar, et al. are carried out at higher temperatures than those of Sharma, et al.

Applicants submit that no proper incentive exists for the suggested combination for at least the reason that the references teach away from such a combination. For instance, Sharma, et al. teaches that the disclosed low temperature processes are preferable to higher temperature processes, as discussed above. In addition, Sharma, et al. teaches that their technique is an improvement over VLS processes such as those of Mujumdar, et al. For example, Sharma, et al. discloses that their technique "does not require creation of quantum sized liquid metal droplets to synthesize nanowires. In addition, it offers advantages such as lower growth temperature, better control over size and size distribution, better control over the composition and purity of the nanowires" (Abstract). Accordingly, Applicants submit that Sharma, et al. teaches away from a combination of their process with high temperature VLS processes requiring formation of quantum-sized droplets of materials such as is disclosed by Majumdar, et al.

In addition, Applicants submit that Majumdar, et al. also teaches away from such a combination. For example, according to Majumdar, et al., the disclosed high temperatures are necessary for the formation process to proceed, as discussed above, and as such, the teachings of this reference are directed away from lower temperature ranges and any combination with lower temperature processes such as that of Sharma, et al.

Applicants submit that the references teach away from the suggested combination, and there exists no proper motivation to combine the references as suggested. As such, Applicants further submit that pending claims 11-37 patentably define over the cited references and request allowance of the claims.

It is believed that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested. Examiner Fuller is invited and encouraged to telephone the undersigned, however, if any issues remain after consideration of this response.

Please charge any additional fees required by this Amendment to Deposit Account No. 04-1403.

Respectfully submitted,

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6/7/06
Date

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